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# Outcome of low-grade degenerative spondylolisthesis treated with or without instrumentation

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**Abstract**
Spondylolisthesis is the anterior translation of cephalad vertebra, in relation to the adjacent caudal vertebra with an intact neural arch. The majority of low-grade listhesis be treated conservatively in the early stages of the disease. In the end, the problem is further compounded by the development of secondary spinal canal stenosis, which leads to the operating room. Therefore, it is necessary to conduct a study to compare the functional and effectiveness of a decompression, with or without instrumentation, for a low-grade, single-level degenerative spondylolisthesis with canal stenosis.
**Purpose:** The study was carried out to compare the functional and clinical outcome of low-grade degenerative spondylolisthesis with a secondary canal stenosis, with or without the instrument.
**Methods:** 40 patients were enrolled and assigned into instrumented or non-instrumented group, 20 patients in each group. The outcome measures were (1) The visual analogue scale to assess the clinical outcome and (2) the Modified Oswestry Disability Index to assess the functional outcome.
**Results:** The improvement in VAS for low back ache was greater in the instrumented group than in the non-instrumented group (91.3% vs 90.5%) with no significant differences ($p$ <0.001) in between the two groups. The improvement in VAS for radiating pain was greater in the non-instrumented group than in the instrumented group (94.9% vs 89.3%; $p$ <0.001). The improvement in ODI was greater in the instrumented group than in the non-instrumented group (69.5% vs 64.6%; $p$ <0.001). Overall outcome was excellent in 70% in instrumented group compared to 35% in the non-instrumented group
**Conclusions:** Functional outcome is higher in the instrumented group & clinical outcome was better for low back ache for patients who underwent instrumentation & for radiating leg pain for patients who underwent non-instrumented procedure. Longer & larger studies may provide a significant outcome. Based on our results & literature review instrumented group is the superior of the two.

**Keywords:** cephalad vertebra, spondylolisthesis, conservatively, functional

## 1. Introduction
Decompression is often necessary in the treatment of symptomatic patients who have degenerative spondylolisthesis and spinal stenosis. Results of recent studies demonstrated that outcomes are significantly improved if posterolateral arthrodesis is performed at the listhesis level. A meta-analysis of the literature concluded that adjunctive spinal instrumentation for this procedure can enhance the fusion rate, although the effect on clinical outcome remains uncertain [1].
There is no consensus on weather fusion or decompression- only surgery leads to better outcomes for patients with low grade degenerative spondylolisthesis. Current trends support fusion but many studies are flawed due to over generalization without consideration of radiological instability & their variable presentations and natural history [2].
Data from one such study suggests that a posterior instrumented reduction and fusion of high-grade spondylolisthesis without decompression of the neural elements can be accomplished with acceptable radiographic and clinical results [3].
Decompression primarily relieves radicular symptoms and neurogenic claudication whereas fusion primarily relieves back pain by elimination of instability. Posterolateral instrumentation enables improved functional outcome, better patient satisfaction and less back and lower limb symptomatology [4].

With advances in understanding of the clinico-functional and pathoradiological correlation, the treatment has changed from various non-operative modalities to decompression and subsequently, decompression and fusion with or without instrumentation. Clinical studies in literature that perform the clinico-radiological and functional outcome assessment are few; studies from India are even more infrequent [5].

Spondylolisthesis is a word derived from the Greek term "*spondylos"*, meaning vertebra, and "*olisthesis"*, meaning to slide. It describes the anterior translation of the cephalad vertebra relative to the adjacent caudal vertebra. The slide or translation of the vertebrae usually happens under two principal pathologies:

- **Degenerative:** Degenerative erosion of the articular surface
- **Fatigue fracture of the posterior arch:** Break or defect in the pars interarticularis (pars).

The purpose of the study is to compare the Functional Outcome using the Modified Oswestry Disability Index (ODI) between the study groups. To compare the Clinical Outcome using the Visual Analog Scale (VAS) between the study groups. To observe the complications while comparing the two groups.

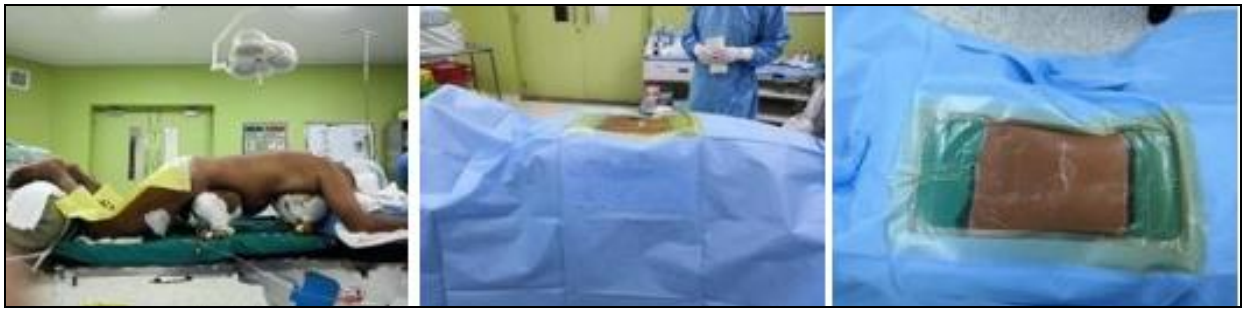
## 2. Materials and Methods

We conducted a prospective cohort study on 40 patients above the age of 40 years of either sex undergoing Decompression of a single level low grade Degenerative Spondylolisthesis (Grade 1 & Grade 2) with Lumbar Canal Stenosis with or without instrumentation, in the Department of Orthopaedics at Vydehi Institute of Medical Sciences and Research Centre, Whitefield, Bengaluru, between January 2019 to June 2020. Patients having systemic infection or infection at the proposed surgical site, mental or physical condition that would invalidate evaluation results, disease of bone metabolism or undergoing any cancer treatment, Lytic spondylolisthesis, High grade spondylolisthesis, osteoporosis or osteomalacia to a degree that spinal instrumentation would be contraindicated were not included in the study. A detailed case history, subjective and physical findings of the patient were recorded as per the questionnaire. Routine plain roentgenograms of the lumbar spine with erect flexion and extension views were obtained and the results recorded. An MRI scan of lumbosacral spine was done in presence of radicular pain or neurological deficits. Based on all available information, a therapeutic and surgical plan was then laid out with a predetermined goal in mind for the surgery. Intraoperative findings confirm or alter the preoperative plan and modifications are made accordingly. Consent was taken for surgery from the patient and his/her guardian. The surgical procedure was planned individually based on patient's age, symptoms and radiological features. Decompression only was planned in individuals with grade 1 listhesis without instability (checked intraoperatively) & in those patients in whom low back ache VAS scores were higher than VAS scores for radiating pain. All patients will be subjected to timely follow ups using VAS scoring & The Modified Oswestry Disability Index at 2 weeks, 6 weeks, 3 months, 6 months, 9 months and 1 year postoperatively.

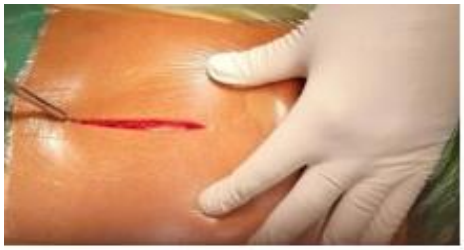
The patient was properly identified by anesthetist, brought to the operating room, and positioned supine on the cart. General anesthetic was delivered and was intubated. Patient was log-rolled onto the Wilson frame. All pressure points were padded. Antibiotics were given. The back was scrubbed, painted and draped under aseptic precautions. A midline incision was made over operative level (example: L5/S1). Lumbar fascia was identified, dissection done up to the desired level spinous process. A hemostat was placed between the spinous processes and its position was confirmed on a lateral radiograph which included the sacrum.

Dissection was then carried down the lamina bilaterally to the level of the facet joints and transverse processes. Segmental, bilateral polyaxial pedicle screw fixation will be placed at all levels treated, by free hand technique. Reduction screws are used selectively as per preoperative planning. The starting point was identified at the juncture of two lines drawn down the transverse process and up the pars. This was at the most inferior portion of the superior facet. The starting point was made with an awl and the pedicle entered with a blunt gear shift up to midpoint of the vertebral body. The hole was tapped to the same level. A feeler was used to confirm solid superior, inferior, medial, and lateral walls and to confirm the presence of bone at the end of the tunnel. Next the screw was inserted. All the screws were inserted in the same manner. Final screw position is confirmed using image intensifier.

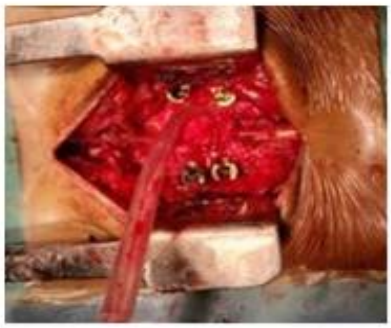
In group 2, decompression was commenced by laminectomy and removal of interspinous ligaments and ligamentum flavum with sufficient decompressive laminotomy superiorly and inferiorly. Nerve root was confirmed to be free & un impinged. Injection triamcinolone was applied locally at the decompression site. Drain was not placed in decompression cases [6].



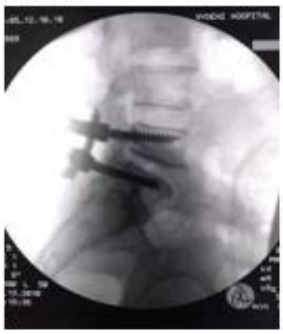
Positioning of Patient and Draping



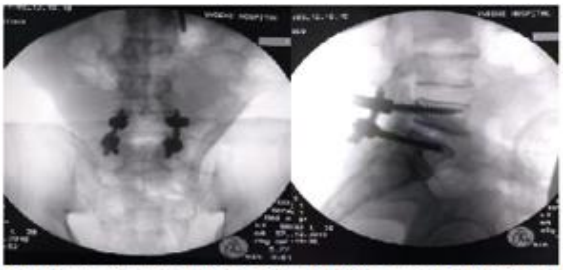
INCISION AND EXPOSURE



PEDICLE SCREW INSERTION



CONFIRMATION OF SCREW POSITION AND REDUCTION UNDER C-ARM



CONFIRMATION OF SCREW POSITION AND REDUCTION UNDER C-ARM

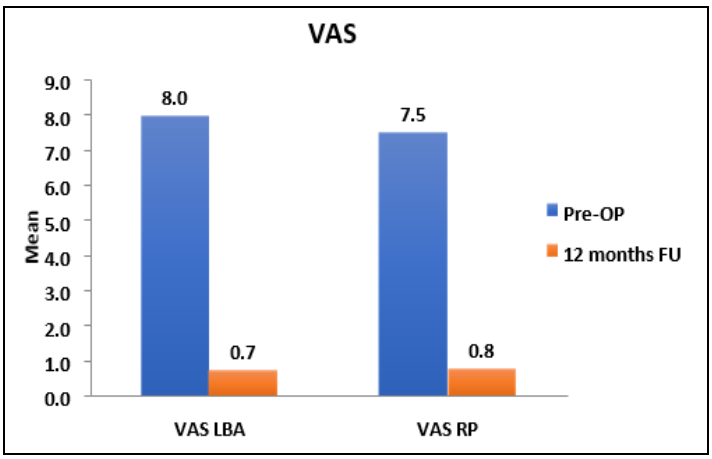
## 3. Results

The study was conducted on 40 patients with low grade spondylolisthesis, of which 20 each underwent decompression with posterior stabilization with PLF (instrumented) and decompression (non-instrumented) only. The patients were followed up for a period of atleast one year. N=20 per group for all the analyses.

**Table 1:** Comparison of VAS in Instrumented Group

| Parameters | Preop | | 12 months FU | | Improvement (%) | t value | p value |
|---|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | | | |
| VAS LBA | 8.0 | 0.7 | 0.7 | 0.7 | 91.3 | 45.3 | <0.001* |
| VAS RP | 7.5 | 2.6 | 0.8 | 0.4 | 89.3 | 26.4 | <0.001* |

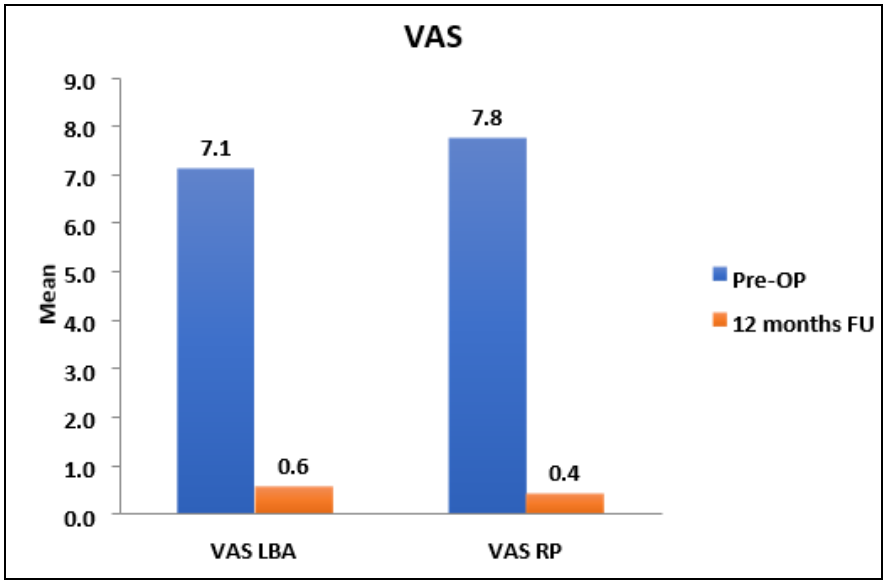
**Note:** * significant at 5% level of significance ($p$<0.05)




**Graph 1:** Comparison of VAS in Instrumented Group

**Table 2:** Comparison of VAS in Non-Instrumented Group

| Parameters | Preop | | 12 months FU | | Improvement (%) | t value | p value |
|---|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | | | |
| VAS LBA | 7.1 | 0.8 | 0.6 | 0.5 | 90.5 | 29.3 | <0.001* |
| VAS RP | 7.8 | 1.0 | 0.4 | 0.5 | 94.9 | 30.2 | <0.001* |



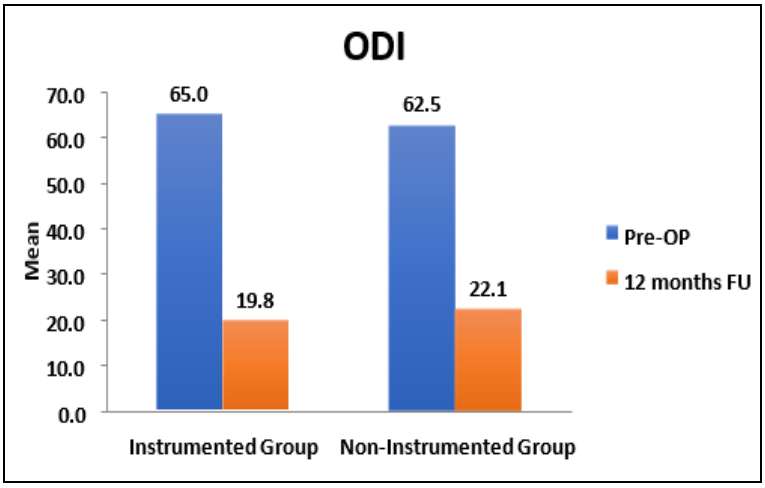

**Graph 2:** Comparison of VAS in Non-Instrumented Group

The mean preoperative VAS scores for low back ache in instrumented & non- instrumented group are 8±0.7 & 7.1±0.8 respectively. The mean VAS scores at one year follow up for instrumented & non-instrumented group 0.7±0.7 & 0.6±0.5 respectively. The improvement postoperatively in both the groups is significant & the percentage of improvement for instrumented & non- instrumented group is 91.3% & 90.5 respectively (p value < 0.001). The mean preoperative VAS scores for radiating pain in instrumented & non- instrumented group are 7.5±2.6 & 7.8±1.0 respectively. The mean VAS scores at one year follow up for instrumented & non-instrumented group 0.8±0.4 & 0.4±0.5 respectively. The improvement post operatively in both the groups is significant & the percentage of improvement for instrumented & non-instrumented group is 89.3% & 94.9 respectively (p value < 0.001).

**Table 3:** Comparison of ODI

| ODI | Preop | | 12 months FU | | Improvement (%) | t value | p value |
|---|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | | | |
| Instrumented Group | 65.0 | 4.3 | 19.8 | 2.8 | 69.5 | 37.7 | <0.001* |
| Non-Instrumented Group | 62.5 | 3.9 | 22.1 | 2.5 | 64.6 | 38.8 | <0.001* |

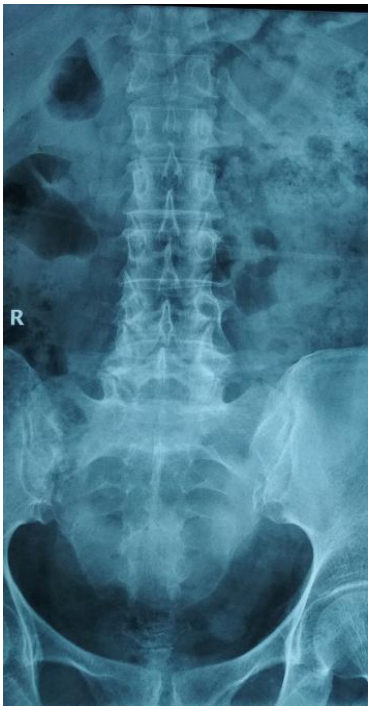
**Note:** * significant at 5% level of significance ($p$<0.05)



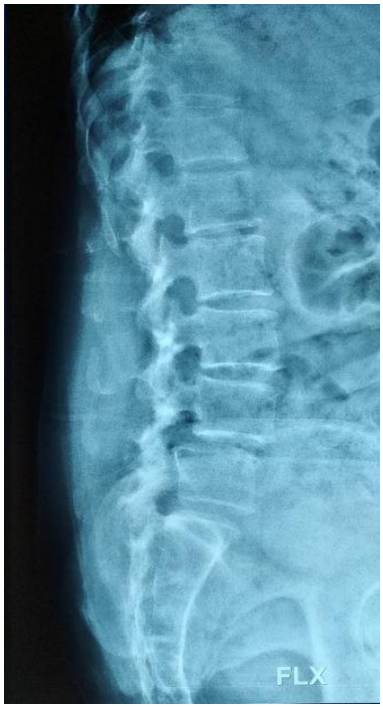

**Graph 3:** Comparison of ODI

The mean preoperative ODI scores in instrumented & non-instrumented groups are 65±4.3 and 62.5±3.9 respectively. The mean ODI scores at one year follow up for instrumented & non-instrumented groups are 19.8±2.8 & 22.1±2.5 respectively. The percentage improvement within both the groups is 69.5% for the Instrumented group & 64.6 % for the Non-Instrumented group and is statistically significant ($P$<0.001).

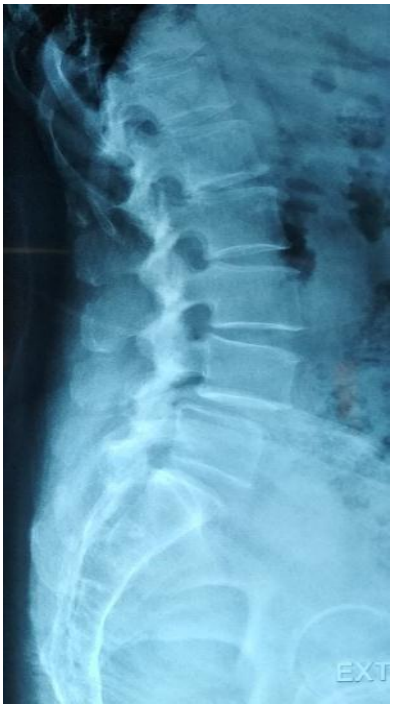
**Illustrative Case: Decompression with Posterior Stabilization**
**50-Year-Old Female**
**L4-L5 Grade 1 Spondylolisthesis**



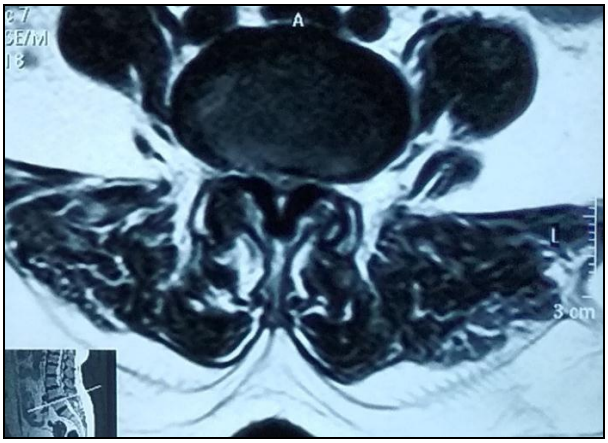

Preop Ap View



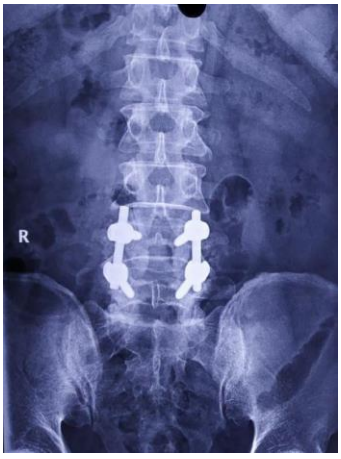

Preop Lat Flexion View



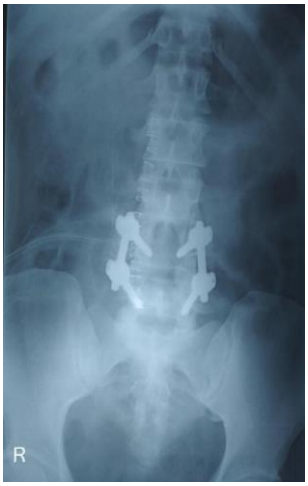

Preop Lat -Extension View



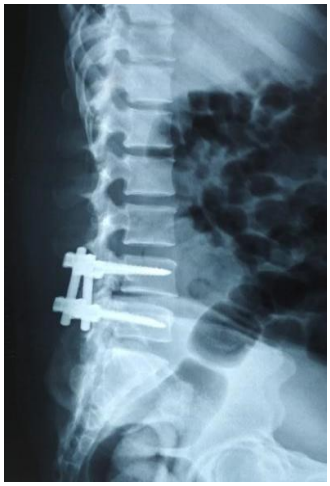

Axial cut at L4-L5 showing canal stenosis



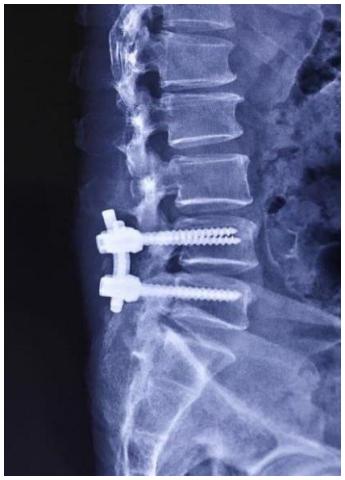

12 Months Follow Up Ap View Lat View




Post Op Ap View



Post Op Lat View



12 Months Follow Up

## 4. Discussion

Spondylolisthesis is a condition that is radio-graphically verifiable and instability is revealed by motion in lumbar segments. Distinguishing specific symptoms of spondylolisthesis from other types of low back pain and sciatica is of utmost importance. Only a small minority of affected individuals ever have symptoms, but this proportion increases with severity of slip.

In this study, we have included cases of grade 1 and 2 (low grade) spondylolisthesis. Most of these patients were initially treated conservatively for 3 months with physiotherapy and medications but the symptoms persisted and for some of them it worsened. Dynamic/stress x-rays were taken revealed instability at the lumbar region.

In this study one of the main indications for surgical intervention is failed conservative management. Fusion is the currently recommended surgical procedure for the treatment of spondylolisthesis.

The goal of the surgical treatment of spondylolisthesis includes: the stabilization of the motion segment, the decompression of neural elements, the reconstitution of disc space height, and the restoration of sagittal plane translational and rotational alignment.

Grob *et al*. reported there was of no difference between decompression group and instrumentation group in VAS score for low back ache but both showed improvement with reoperation though there is a lack of precise data [7]. It was noted in our study that the percentage of improvement for instrumented & non-instrumented group is 91.3% & 90.5% respectively (p value < 0.001).

The improvement in VAS for radiating pain postoperatively in both the groups is significant & the percentage of improvement for instrumented & non-instrumented group is 89.3% & 94.9 respectively (p value < 0.001).

Sigmundsson *et al*. (2015) [8] observed that in the Persistent Back Pain group, patients decompressed and fused improved more than patients who underwent decompression & that the postoperative ODI scores were generally lower, with a reduction of 15% in decompression group and 21.1% in decompression with fusion group. These were consistent with our results which showed an improvement within both the groups of 69.5% for the Instrumented group & 64.6% for the non-instrumented group and is statistically significant ($P$<0.001).

Limitations are inherent with all research studies. Our study had two important limitations that must be considered with the results. Our sample size is 40, 20 per group, which is relatively small when compared to many prospective studies. Our duration of study is one and half year. All the results are favourable towards posterior stabilization with decompression with PLF, but an increased sample size and longer follow up could show statistically significant values support the trend. Apart from this our operative technique and analysis of results are consistent with the standard literature.

Our results, in combination with the available literature, strongly support for low grade spondylolisthesis with predominant back pain treated with instrumented (posterior stabilization with decompression with PLF) is the better treatment option & for patients with predominant leg pain non-instrumented (decompression alone) would suffice, added that there is no instability.

The cost effectiveness of the non-instrumented procedure is more acceptable to patients of lower socio-economic strata of India which can provide them with adequate relief in low grade spondylolisthesis

## 5. Conclusion

This is a prospective clinical study of 40 patients suffering with grade 1 and 2 spondylolisthesis presenting to the department of Orthopaedics, undertaken to compare functional and clinical outcomes of instrumented & non-instrumented. Patients were evaluated clinically and functionally, to determine need for surgery and those meeting the inclusion and exclusion criteria were included in the study. Current recommendation for surgical management of Spondylolisthesis is fusion.

Of the 40 patients in the study, 20 underwent posterior stabilization with decompression & PLF (instrumented group) and 20 underwent decompression (non-instrumented group) alone. The VAS scores for low back ache and radiating pain were comparable in both the groups' pre operatively. Within the groups, all the patients had significant improvement in VAS scores. When compared to instrumented group, patients had about 2% better improvement in VAS for back pain and 5% better improvement in radiating pain. The improvement in ODI scores was higher in instrumented group than in noninstrumented group. In conclusion, posterior stabilization with decompression & PLF (instrumented group), is safe and efficient technique. Short term one year follow up showed better clinical & functional outcome compared to decompression (non-instrumented group).

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